



Caltrans Division of Research,  
Innovation and System Information

# Research Results

Transportation  
Safety and  
Mobility

**MARCH 2013**

**Project Title:**

Crash Attenuator Usage Along  
Travelways and in Work Zones

**Task Number:** 1739

**Completion Date:** June 30, 2012

This project developed a method for evaluating the lifecycle costs for highway crash attenuators by considering purchase and repair costs, accessibility, and frequency of impact to provide traffic designers a means to identify the most cost-effective product for a given site.

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## Crash Attenuator Usage Along Highways

*Methodology for evaluating site suitability and long-term costs  
of crash attenuators*

### WHAT WAS THE NEED?

Crash attenuators are installed along roadways to help protect motorists. They are designed to safely decelerate or redirect a vehicle and reduce the risk to the vehicle's occupants and other nearby vehicles. All attenuators must meet federal safety standards and be approved by Caltrans. The requirements for approval are based on crash tests and the crash effects on vehicle occupants. No consideration is given to the durability of the attenuator after impact and the associated costs.

Crash attenuators offer different levels of performance and have a wide range of costs, up to \$60,000 per installation. Attenuators are designed to be hit, so repairs must be considered as part of the overall cost. Repair costs fluctuate greatly based on the type of impact and how accessible the location is.

After being hit, attenuators can be either removed (sacrificed) or repaired. Restoring a crash attenuator can require multiple trips, starting with an inspection to assess the damage and the parts needed. Subsequent trips might require crews to control traffic to complete the work. A new class of attenuators that are easier to reset in place cost more upfront but are less expensive to maintain. The cost-effectiveness of these resettable class attenuators is often overlooked with the current focus on initial costs rather than long-term upkeep.

### WHAT WAS OUR GOAL?

The goal of this research was to develop a methodology for comparing the lifecycle costs of highway crash attenuators to identify which product is best for a given site based on accessibility, frequency of impact, initial costs, and ongoing repairs.



*Protection at exit ramp*



Caltrans improves mobility across  
California by performing applied  
research, developing innovations,  
and implementing solutions.



## WHAT DID WE DO?

Caltrans, in partnership with UC Davis's Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center, met with district maintenance and design staff to develop a methodology for selecting crash attenuators for a specific location by assessing various factors. The performance of different attenuators was reviewed and classified based on the typical repairs needed after impact. The researchers developed a formula to help quantify the value of specific attenuator features, a location's accessibility for repair crews, repair costs, and other variables associated with the likelihood or frequency of impacts.

## WHAT WAS THE OUTCOME?

This research determined that two of the most important site attributes influencing lifecycle costs of crash attenuators are the expected frequency of impact and the access factor—how difficult it is for crews to access the particular location to make repairs. For highway sites with elevated values of either of these factors, in-service maintenance costs are the most important consideration, and products designed for cost-effective reset or repair are preferred. The research also identified a class of severe-duty attenuators that can be reset by crews after impact with few or no repairs or replacement parts.

The results of this methodology are applicable to other agencies responsible for designing and maintaining crash attenuators. Additional data on repair costs and the type of impacts most frequently seen will enhance the accuracy of the model.

## WHAT IS THE BENEFIT?

Substantial savings can be realized by analyzing the lifecycle costs of crash attenuators and choosing the appropriate product for the site. Some sites can use a less expensive attenuator because few incidents occur. For those sites that are difficult to access and experience frequent collisions, installing a more robust attenuator would cost more initially but reduce maintenance costs in the long term. Systematically evaluating the location might also reveal that a sacrificial product could be more appropriate and cost-effective.

## LEARN MORE

To view the full report:

<http://ahmct.ucdavis.edu/pdf/UCD-ARR-10-07-16-01.pdf>



*Protection at bridge column*